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PROVIDED TO THE WORKING GROUP ON SEPT 2, 1999

REQUESTED COMMENTS BY 9/9/99 -

MEMORANDUM

To: Chris Weis, Bonnie Lavelle

From: Bill Brattin, Adrian Bradley

Date: August 27, 1999

RE: Vasquez Boulevard and I-70 Site
Draft Vegetable Sampling Design

cc: Project files

This memorandum summarizes the key design elements for the residential garden vegetable sampling portion of the VBI70 Phase 3 project. Please feel free to contact me at (303) 292-4142 if there are any issues or points that require additional discussion.

Residential Garden Vegetable Sampling Plan

Objective

Residents may be indirectly exposed to chemicals of potential concern in yard soil by ingestion of home-grown garden vegetables. Very limited data (ISSI 1999b) suggest that this may not be a significant source of concern, but the data are too limited to support reliable decisions. Consequently, the objective of this component of the Phase 3 project is to:

> ***Collect sufficient numbers of home grown garden vegetables from within the study area to determine whether this is a significant exposure pathway, and, if so, determine the level in soil that is associated with unacceptable levels in garden vegetables.***

Data Quality Objectives

State the Problem

Vegetables grown in contaminated soil may take up chemicals from the soil and

accumulate them in edible portions of the vegetable. Uptake of arsenic and lead from soil into vegetables can be estimated using mathematical models based on observations at other locations, but the actual level of uptake is very dependent on site-specific soil conditions. Thus, measurements of chemical levels in actual site vegetables are much more reliable than calculated predictions. However, available site-specific data (ISSI 1999b) are too limited to reliably evaluate the potential health risk from this pathway.

Decisions to Be Made

The decision to be made is whether or not ingestion of vegetables grown in contaminated soil is of potential health concern to residents, and if so, to define the concentration value in soil that leads to unacceptable levels of COPCs in garden vegetables.

Types of Input Needed

The basic approach for estimating exposure from garden vegetables is to determine the relationship between the concentration of a chemical in soil and the concentration in a vegetable grown in that soil. This is done by obtaining "paired" data on contaminant levels in garden soil and vegetables grown in that soil (i.e., both measurements are from the same property), and fitting the data to an appropriate equation (linear or non-linear) using computer-based regression techniques. Thus, the inputs needed to establish the parameters of this relationship are an adequate set of paired measurements of COPC levels in garden soil and co-located garden vegetable samples.

Bounds of the Study

Any residence within the study area that has a vegetable garden is a candidate for sample collection, if authorization is granted. Selection of specific gardens to be sampled will be done to provide spatial representativeness (across neighborhoods), and will also be stratified to ensure a wide range in soil sample concentrations. After receipt of the Phase 3 soil results, properties with gardens will be divided into three categories (high, intermediate, and low), based on arsenic concentrations. Four gardens will be selected from each category, and if possible, at least one garden will be located in each of the neighborhoods within the VBI70 site. The objective is to collect samples from 12-15 residential gardens, depending on the number of existing gardens and the ability to gain access.

Decision Rule

The concentration of COPCs in home-grown vegetables will be calculated from measured soil concentrations using the best-fit equation through site-specific data. Both measured and predicted values will be used to evaluate potential health risk to residents, using appropriate values for garden vegetable intake rates.

Acceptable Limits on Decision Errors

In keeping with standard USEPA approaches, the principal goal is to ensure that there is no more than a 5% probability that a risk estimate based on measured garden vegetable values will underestimate the true risk. This will be achieved by using upper-bound estimates of garden vegetable intake rates, coupled with 95% upper confidence limits on soil concentration values in garden areas. The probability of committing a Type II error (false negative) should be minimized by the number of samples being collected.

Study Design

Based on the data quality objectives outlined above, the key design elements of the garden vegetable sampling component of the Phase 3 project are as summarized below.

Sample Number and Location

If possible, residences to be sampled will be selected to provide a range of spatial coverage (spanning multiple neighborhoods), and a range of soil concentrations (based on measured levels in yard soil). Specific locations will be selected after receipt of the Phase 3 soil sampling data, and gardens will then be stratified into three categories (high, intermediate, and low), based on the arsenic results of the yard soil sampling study. Five gardens from each of the three categories will be selected randomly, while simultaneously distributing them to ensure spatial representativeness across the study boundaries. The goal is to obtain garden vegetable and soil samples from at least 15 different residences. Within each location, one composite garden soil sample and one sample of each type of vegetable grown in the garden will be collected.

Vegetable Samples

In order to assess the potential human health risk associated with the ingestion of vegetables grown on soil with elevated arsenic and lead levels, a representative sample of each type of vegetable grown in each garden will be collected. A minimum of 100g (wet weight) is required for each analysis. Results will be reported on a dry weight basis.

Soil Samples

Within each garden, a single composite soil sample will be collected. This will consist of a minimum of three and a maximum of eight sub-samples collected next to each plant that is sampled.

Analyte List and Methods

Analyte List

Available data are sufficient to establish that the contaminant of chief human health

concern at this site is arsenic and lead. Other chemicals either are not of health concern, or contribute a risk much lower than that contributed by arsenic. Thus, the analyte list for all samples collected during this project is:

Arsenic
Lead

Analytical Method and Detection Limits

Lead and arsenic will be measured in vegetable samples by any of the following methods: ICP (EPA Method 6010B); ICP-MS (EPA Method 6020); or GFAA (EPA Method 7060, 7421). Detection limits will be no higher than:

Arsenic: 0.05 ppm (dry weight)
Lead: 0.05 ppm (dry weight)

Data Interpretation/Data Use

Data collected from this study will be used to determine if ingestion of vegetables grown within the VBI70 site poses a significant human health risk. Measured values will be used to calculate a preliminary risk estimate based on site-specific data. In addition, results of the vegetable analysis will be compared with the observed soil concentration of arsenic and lead at each residence, to determine the concentration value in soil that leads to unacceptable levels of COPCs in garden vegetables.

Date: August 27, 1999 (Rev. # 0)

SOP No. ISSI-VBI70-##

Title: SOIL AND VEGETABLE SAMPLING FOR RESIDENTIAL GARDENS

APPROVALS:

Author _____ ISSI Consulting Group, Inc. Date: August 27, 1999

SYNOPSIS: A standard method for collecting samples of soil and vegetables from residential gardens is described. Protocols for sample collection, preparation, and handling are provided.

Received by QA Unit:

REVIEWS:

TEAM MEMBER	SIGNATURE/TITLE	DATE
EPA Region 8	_____	_____
ISSI Consulting Group, Inc.	_____	_____

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standard method for collecting soil and vegetable samples from residential gardens. This SOP does not apply to the sampling of fruit-bearing trees. This SOP is intended for use by employees of USEPA Region 8, or contractors and subcontractors supporting USEPA Region 8 projects and tasks. Samples collected using this SOP will produce data that can be used to support risk evaluations. Deviations from the procedures outlined in this document must be approved by the USEPA Region 8 Remedial Project Manager or Regional Toxicologist prior to initiation of the sampling activity.

2.0 RESPONSIBILITIES

The Field Project Leader (FPL) may be an USEPA employee or contractor who is responsible for overseeing the residential vegetable garden sampling activities. It is the responsibility of the FPL to:

1) Ensure that all field sampling team members are familiar with the requirements of this SOP, and that all work is done in accord with this SOP and the site-specific sampling plan, unless deviations are specifically authorized by the appropriate USEPA Region 8 personnel (Remedial Project Manager or Regional Toxicologist).

2) Discuss with appropriate USEPA Region 8 personnel (Remedial Project Manager or Regional Toxicologist) any situations which may require changes or deviations from the SOP, or the site-specific sampling plan, and receive authorization and instruction on appropriate methods for dealing with unanticipated problems.

Field personnel performing residential garden soil and vegetable sampling are responsible for:

1) Understanding and adhering to the methods and approaches specified in this SOP.

2) Requesting guidance and instruction from the FPL whenever a situation arises that is not clearly covered in the SOP.

3.0 EQUIPMENT

- Soil augers - Various models of soil augers are acceptable and selection of the specific brand and make of tool is at the discretion of the contractor implementing the field work. Augers are usually made of stainless steel, and should be capable of retrieving a cylindrical plug of the dimensions specified in the sampling and analysis plan. In general, samples of soil will be 2 inches in diameter and 6 inches in depth. In all cases, the procedures recommended by the manufacturer

should be followed with regard to use of the auger. Augers with disposable plastic sleeves may be employed to minimize the decontamination effort.

- Collection containers - plastic zip-lock bags.
- Trowels - for extruding the soil from the auger; for digging up plants. May be plastic or stainless steel.
- Gloves - for personal protection and to prevent cross-contamination of samples. May be plastic or latex. Disposable, powderless.
- Squeeze Bottle - for holding deionized water.
- Deionized Water - for rinsing vegetable samples.
- Nylon Brush - for removing soil particles adhering to the surface of vegetables.
- Wipes - disposable, paper or baby wipes. Available for field sampling personnel.
- Stainless Steel Knife or Scissors - for cutting off plant parts not included in the sample.
- Field clothing and Personal Protective Equipment - as specified in the Health and Safety Plan.
- Field notebook - a bound book used to record progress of sampling effort and record any problems and field observations during sampling.
- Three-ring binder book- to store necessary forms used to record and track samples collected at the VBI70 site. Binders will contain the Garden Soil and Vegetable Data Sheet, Site Diagram, and sample labels for each day. Example forms are provided in Attachment 1.
- Permanent marking pen - used as needed during sampling and for documentation of field logbooks and data sheets.
- Measuring tape or wheel - used to measure each garden.
- Measuring tape or pocket ruler - used to measure the length of soil core in the soil coring device.
- Trash Bag - used to dispose of gloves and wipes.

4.0 SAMPLING PLAN

At each garden selected for sampling, samples of garden vegetables and of garden soil will be collected as detailed below.

4.1 Garden Vegetable Sampling

4.1.1 Measure the garden and Prepare a Diagram

Using a measuring wheel or measuring tape, measure the dimensions of the garden. If there are no clear boundaries of the garden, measure to about six inches from the end of each row or cluster of plants.

Prepare a diagram of the garden using the Garden Soil and Vegetable Data Sheet (Attachment 1). Indicate the location of different types of crops within the garden, as well as any anomalies in soil color, soil texture, or any noticeable differences among the plants (i.e., one side or patch of the garden is dead). As a time saving mechanism, a coding system may be used on the site diagram (c = corn, t = tomato, etc.), but the coding definition **must be indicated** in the plant type section of the form (see Attachment 1). Record the locations of vegetable and soil samples collected from the garden, using a circled 'v' for vegetable samples and a circled 's' for soil sub-samples. Follow the collection procedures as detailed below.

4.1.2 Collection of Leafy-Type Vegetables

Leafy-type vegetables include crops such as lettuce, cabbage, beet greens, turnip greens, spinach, rhubarb, parsley, and cilantro. Samples of this type are collected as follows.

Use a new pair of gloves for every sample. Select one or more plants to collect for the sample, and mark the location of those plants on the diagram. The minimum amount that must be collected is 100 g (wet weight). Sample weight can be determined by the use of a balance, or it can be estimated using an object that is known to be approximately 100g, and comparing the sample weight to the weight of that object. It is not necessary to weigh the sample to precisely 100g.

Using the knife or scissors, cut off all of the plant material, as close as possible to the surface of the soil. If the plant is very large, select half of the leaves, or half of the head (cabbage, lettuce, etc.). Shake off any dirt, and using a squeeze bottle filled with deionized water, rinse off the surface of the leaves. Hold the sample so that all of the water is draining off of the leaves and back into the garden. Shake off as much excess water as possible before placing into the ziplock

bag. If the sample is too large to fit into the bag, remove a small portion so that it will fit securely in the bag. Do not force the sample into the bag, as this may result in the bag opening during transport.

Select two sample ID labels, and attach one to the bag, and one to the appropriate space on the Garden Soil and Vegetable Data Sheet. All samples must be placed immediately on wet ice to minimize the chances of degradation prior to analysis.

Follow the decontamination procedures described in Section 5.0 to decontaminate any equipment that was used. Remove disposable gloves and place in the trash bag for disposal.

4.1.3 Collection of Fruit-Type Vegetables

Fruit-type vegetables include crops such as peppers, tomatoes, zucchini, yellow squash, summer squash, okra, cucumbers, broccoli, cauliflower, eggplant, snowpeas, yellow wax beans, green beans, corn, celery, asparagus, brussels sprouts, artichokes. Samples of this type are collected as follows.

Use a new pair of gloves for every sample. Select one or more plants to collect for the sample, and mark the location of the plants on the diagram. The minimum amount that must be collected is approximately100 g (wet weight). Refer to Section 4.1.2 for a description of estimating sample weight in the field. Using the knife or scissors, cut off the plant part included in the sample. If the fruit is very small, select several individuals from the same plant, or use additional plants. Using a squeeze bottle filled with deionized water, rinse off all visible soil adhering to the surface of the fruit(s). Shake off any excess water, and place the sample into the ziplock bag.

Select two sample ID labels, and attach one to the bag, and one to the appropriate space on the Garden Soil and Vegetable Data Sheet. All samples must be placed immediately on wet ice to minimize the chances of degradation prior to analysis.

Follow the decontamination procedures described in Section 5.0 to decontaminate any equipment that was used. Remove gloves and place in the trash bag for disposal.

4.1.4 Collection of Root-Type Vegetables

Root-type vegetables include crops such as radishes, turnips, carrots, potatoes, beets, parsnips, rutabegas, kohlrabi, jerusalem artichoke, onion, sweetpotatoes, leeks. Samples of this type are collected as follows.

Use a new pair of gloves for every sample. Select one or more plants to collect for the sample, and mark the location of the plants on the diagram. The minimum amount that must be collected is approximately 100g. Refer to Section 4.1.2 for a description of estimating sample weight in the field. If the root is very small, use multiple plants to acquire the amount necessary for analysis.

Using the trowel, dig a circle around the base of the plant, then dig up the entire plant, gently removing it from the soil. Shake off as much soil from the root as possible, then use the knife or scissors to cut off the top of the plant. Do not cut the top of the root portion of the plant. If the top of the plant is being sampled (beet greens, turnip greens, etc.), follow the procedures in Section 4.1.2 and prepare this portion of the sample before preparing the root portion. Using a squeeze bottle filled with deionized water, rinse off all visible soil adhering to the surface of the root(s). If there are still soil particles on the root surface, use the nylon brush to remove all visible soil particles. After brushing, rinse once more with deionized water. Multiple brushings and rinses may be required to remove all of the soil. After the soil is removed, shake off the excess water and place the sample into a plastic ziplock bag.

Select two sample ID labels, and attach one to the bag, and one to the appropriate space on the Garden Soil and Vegetable Data Sheet. All samples must be placed immediately on wet ice to minimize the chances of degradation prior to analysis.

Follow the decontamination procedures described in Section 5.0 to decontaminate any equipment that was used. Remove disposable gloves and place in the trash bag for disposal.

4.2 Residential Garden Soil Sampling

Residential garden soil samples will be composited, which requires soil collection from multiple (sub-sample) points. These soils are then mixed and used as a measure of the concentration averaged over the entire area (garden). Surficial soil samples (0-6 inch depth) will be collected.

The surficial sampling locations within a garden will be based on the collection of vegetable samples. At each vegetable sample location, a corresponding soil sub-sample will be collected. An independent chemical analysis will not be performed for each of the sub-samples collected from each garden, because the goal is to determine the overall concentration in the soil in which the vegetables are grown. Rather, one composite sample will be collected per garden, consisting of six sub-samples.

Follow the steps outlined in Section 4.1 before collecting any samples.

4.2.1 Surface Soil Collection

Before collecting any samples, mark the location of each sub-sample on the site diagram, using a circled 's' (see Attachment 1). Sub-samples should be located as close as possible to the plant(s)

being sampled. A minimum of three and a maximum of eight sub-samples should be included in the composite for each garden. In gardens with less than three sampled plants, sub-samples should be collected in an area that is surrounded by vegetables. Any anomalies in soil color, texture, or plant appearance (i.e., dead or discolored plants) must be recorded on the Garden Soil and Vegetable Data Sheet.

Use a new pair of gloves to collect the soil sample. New gloves do not have to be worn for each sub-sample, since they will be composited in the same ziplock bag.

Place the soil coring tool on the ground and position it vertically. Holding the tool handle with both hands, apply pressure sufficient to drive the tool approximately six inches into the ground while applying a slight twisting force to the coring tool. Remove the tool by pulling up on the handle while simultaneously applying a twisting force. If the sample was retrieved successfully, a plug of soil approximately six inches long should have been removed with the coring tool.

Hold the soil coring tool horizontally or place it on the ground. Using a clean spatula or knife, remove the soil collected at depth greater than six inches from the end of the sampling tool. Allow this soil to fall back into the garden. Use a trowel to extrude the soil from the auger, pushing the six-inch soil plug from the coring tool so that it falls directly into the sample container. Repeat the steps outlined above until all of the sub-samples have been collected.

Sample preparation homogenization will be performed in accord with the Sample Preparation SOP (#MK-VBI70-05).

If sampling equipment is to be re-used, follow the decon procedures outlined in Section 5.0 before collecting the next composite sample.

4.3 SAMPLE TRANSPORT

After collecting all of the samples, check to make sure that each sample label ID number matches the ID number on the Data Sheet. Samples must be transported to the laboratory at the end of each day, on wet ice (4°C). Samples should be packed so as to minimize degradation of plant material (e.g., soil samples should be not be packed on top of leafy samples). Chain-of-custody (COC) forms must be included in each cooler. Forms should be sealed inside a plastic bag to protect against possible water damage during transport. COC procedures are described in the site-specific sampling plan.

5.0 DECONTAMINATION

The equipment used for sampling, including augers, trowels, knives, and scissors, will be decontaminated between different vegetable samples, separate soil composites, and following the last sample collected daily. Sampling equipment will be decontaminated by the following procedure:

- Equipment must be decontaminated immediately following sample collection at the location/property from which the sample was collected.
- Equipment must be washed with a low- or non-phosphate detergent and tap water, using a brush as necessary.
- Equipment must be triple rinsed with deionized water.
- After decontamination, equipment and tools should be protected by placing them in clean containers and taking care not to allow contact with surface soils.

All personnel and clothing should be inspected following sample collection at each property and, if necessary, decontaminated to remove any potential harmful substances that may have adhered to them. Disposable, pre-moistened wipes will be available for personnel to wash their face and hands. Used gloves and wipes must be contained in a plastic bag and disposed as municipal waste.

6.0 SITE CLEAN-UP

Each hole made in the garden must be backfilled with clean topsoil and tamped down lightly.

Wherever possible, soil that is removed, but not retained as part of the composite sample should be replaced in the same hole.

7.0 RECORD KEEPING AND QUALITY CONTROL

Each field crew will carry a three-ring binder book that contains the Garden Soil and Vegetable Data Sheet, and sample labels. In addition, a field notebook should be maintained by each individual or team that is collecting samples, as described in the site-specific sampling plan. At the end of each day, the field crews will submit the site sketches and data sheets to the FPL. Each sampled garden must have site sketches with vegetable sample locations, soil sub-sample locations, and sample ID labels, as described in Section 4.1 and 4.2. Deviations from this sampling plan should be noted in the field notebook, as necessary.

For each property, the notebook information must include:

e. date
f. time
g. personnel
h. weather conditions
i. sample identification numbers that were used
j. locations of any samples and sub-samples that could not be collected
k. descriptions of any deviations to the Residential Garden Vegetable Sampling Plan and the reason for the deviation.

Samples taken from soils with visible staining or other indications of non-homogeneous conditions should also be noted.
Field personnel will collect the proper type and quantity of quality control samples as prescribed in the site-specific sampling plan.

Logbook DCN _____

ATTACHMENT 1
GARDEN SOIL AND VEGETABLE DATA SHEET

PHASE: 3 **DATE:** _____

SAMPLE COLLECTION METHOD: ISSI-VBI70-## Revision 0 **TIME:** _____

SAMPLE TEAM ID: _____ **CLASS:** FS (Field Sample)

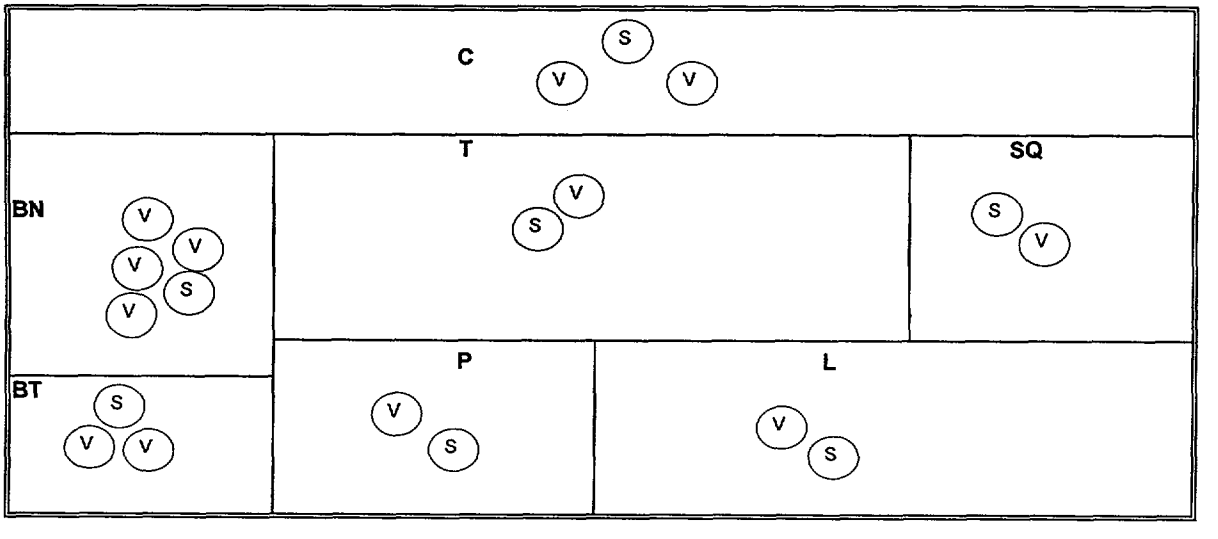
ADDRESS: _____
House# *Street Name*

VEGETABLE TYPE(S)	SAMPLE ID LABEL	SOIL SAMPLE ID LABEL
CORN (C)	3-#####-GV	3-#####-GS
TOMATOES (T)	3-#####-GV	
SQUASH (SQ)	3-#####-GV	
BEETS (BT)	3-#####-GV	
BEANS (BN)	3-#####-GV	
LETUCE (L)	3-#####-GV	
PEPPER (P)	3-#####-GV	
	3-#####-GV	
	3-#####-GV	
	3-#####-GV	

(S) = soil sub-sample

(V) = vegetable sample

SITE DIAGRAM



Master Logbook Page _____